River Information Management in Japan

Kunihiro Yamada
Director of River Information Office
River Planning Division
River Bureau
Ministry of Land, Infrastructure and Transport

Fourth Meeting on Flood Control and Water Resources Management between USACE and MLIT of Japan
February 2008

Contents

1. Objectives of river information management

2. Collection, processing and provision of real-time data

3. Provision of disaster information under normal conditions

4. Future steps

1. Objectives of river information management

Accurate, reliable and quick collection, processing and dissemination of river information (e.g. rainfall amounts and water levels in rivers)

River information

Rainfall amounts
Water quality
Drawings
Water levels
Images
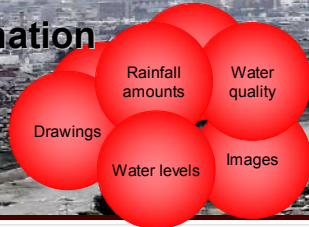
Collection
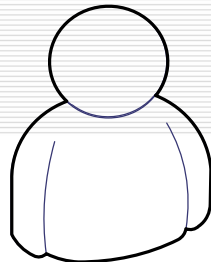- Refinement of planar data
- Refinement of image data

Processing
- Centralization of data
- Refinement of prediction data

Provision
- Refinement of contents
- Improvement of information dissemination tools

User

➢ **Increasing the efficiency of river-related work**

➢ **Enhancing river administration services through information dissemination to the public**

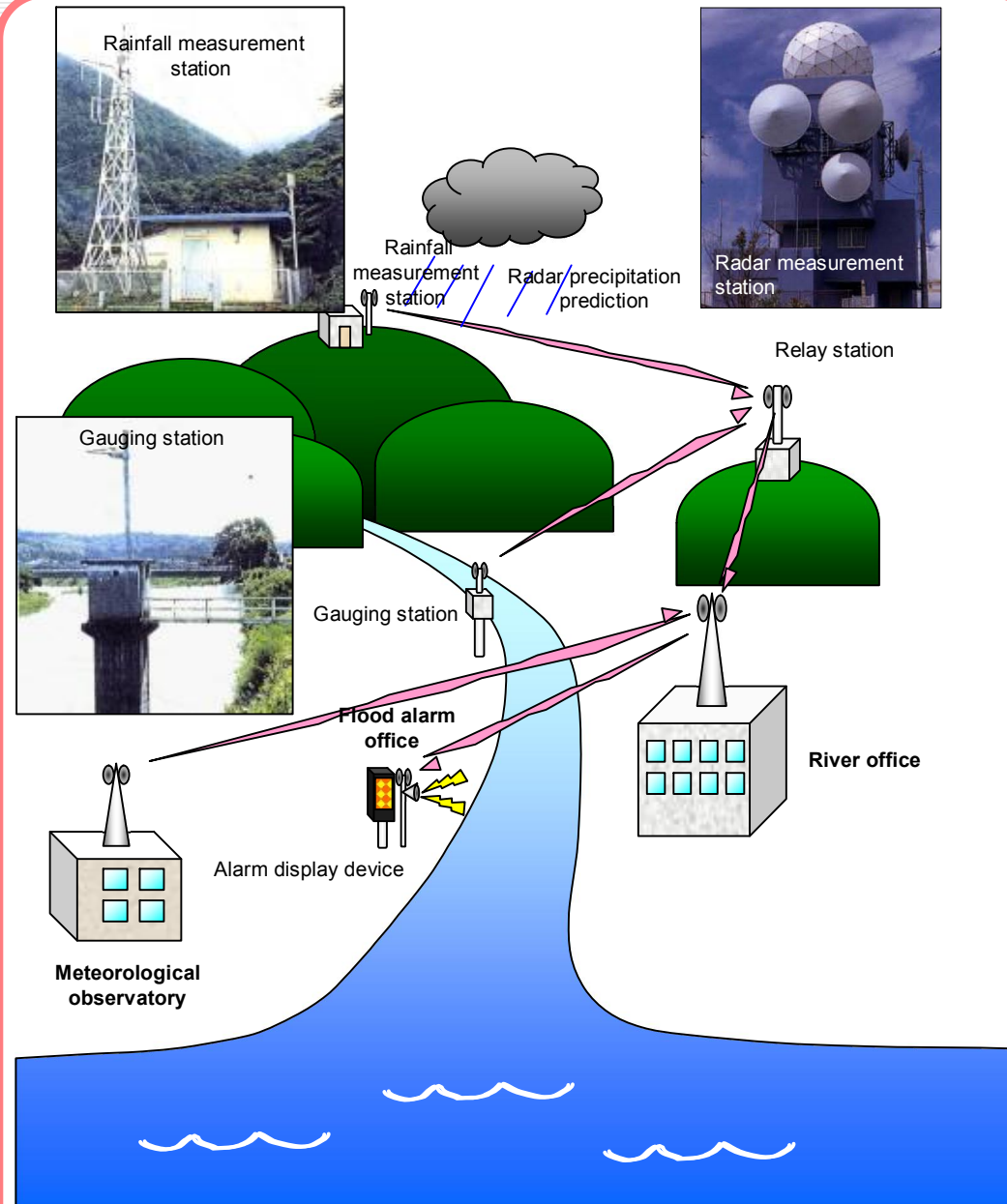# 1-1. Increasing the efficiency of river-related work

Increasing the efficiency of and reinforcing facility operation

施設の遠隔操作

Increasing the efficiency of and reinforcing water level prediction

Rainfall measurement station

Rainfall measurement station

Radar precipitation prediction

Radar measurement station

Relay station

Gauging station

Gauging station

Flood alarm office

River office

Alarm display device

Meteorological observatory

Increasing the efficiency of monitoring

Surveillance camera

Rainfall measurement station

Rainfall measurement station

Radar precipitation prediction

Radar measurement station

Relay station

Regional FM radio station

Gauging station

Newspapers

Media

Radio station

Gauging station

The Internet

Broadcasting station/CATV

Flood alarm office

Alarm display device

River office

Meteorological observatory

Local municipality/public institution

River information bulletin board

Information provision via cellular phone or personal computer

2006/01/22 16:05

Delivery of an image to a TV screen

Nakahara-ku, Kawasaki

Live broadcast via a Ministry of Land, Infrastructure and Transport camera

Ohta Ward, Tokyo

Downstream

Tama River
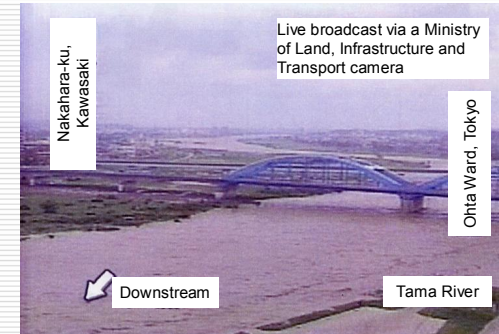
Provision of information in front of a station

4

2. Collection, processing and provision of real-time data

2-1. Collection of real-time data

2-2. Processing of real-time data

2-3. Provision of real-time data

2-1. Collection of real-time data

2-1-1. Collection of point data
(e.g. rainfall amounts, water levels and water quality)

- Telemetry system
- Installation of private radio lines

2-1-2. Collection of area data (rainfall amounts)

- Radar rain gauge

2-1-3. Collection of image data

- CCTV network
- Fiber optic network

2-1-1. Telemetry system

Number of telemetry stations[1]

	River Bureau	Municipality	Road Bureau	Japan Meteorological Agency	Maritime Safety Agency	Geographical Survey Institute	Japan Water Agency	Other organization	Total
Rainfall amount	2238	4088	1010	1326	0	0	100	115	8877
Mean rainfall amount in the basin	818	295	0	0	0	0	6	84	1203
Snow cover	128	30	1	16	0	0	10	2	187
Water level	1886	3654	0	0	0	0	74	18	5632
Water intake	25	39	0	0	0	0	5	2	71
Water quality	310	26	0	0	0	0	58	1	395
Dam	120	185	0	0	0	0	27	150	482
Weir	61	12	0	0	0	0	15	2	90
Pump station	252	69	0	0	0	0	3	1	325
Weather	33	0	0	0	0	0	7	0	40
Oceanographic conditions	29	53	0	66	29	25	3	0	205
Groundwater level	16	0	0	0	0	0	0	0	16
Total	5916	8451	1011	1408	29	25	308	375	17523

[1] Stations using a uniform river information system (as of March 2007)

2-1-2. Radar rain gauge
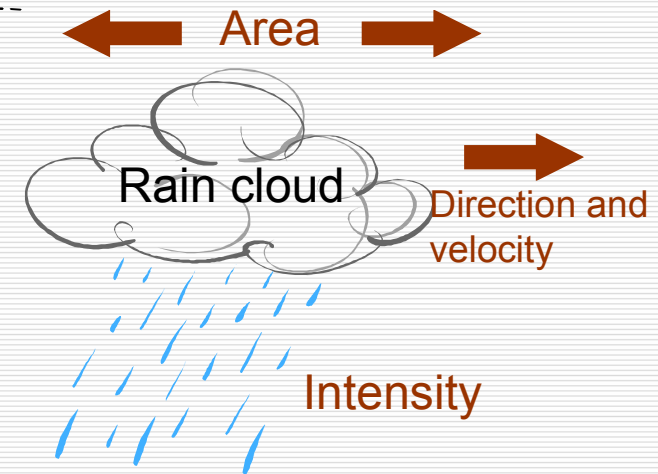
Radar rain gauge system

Quantitative display: 240 km (120-km radius)

Radar station
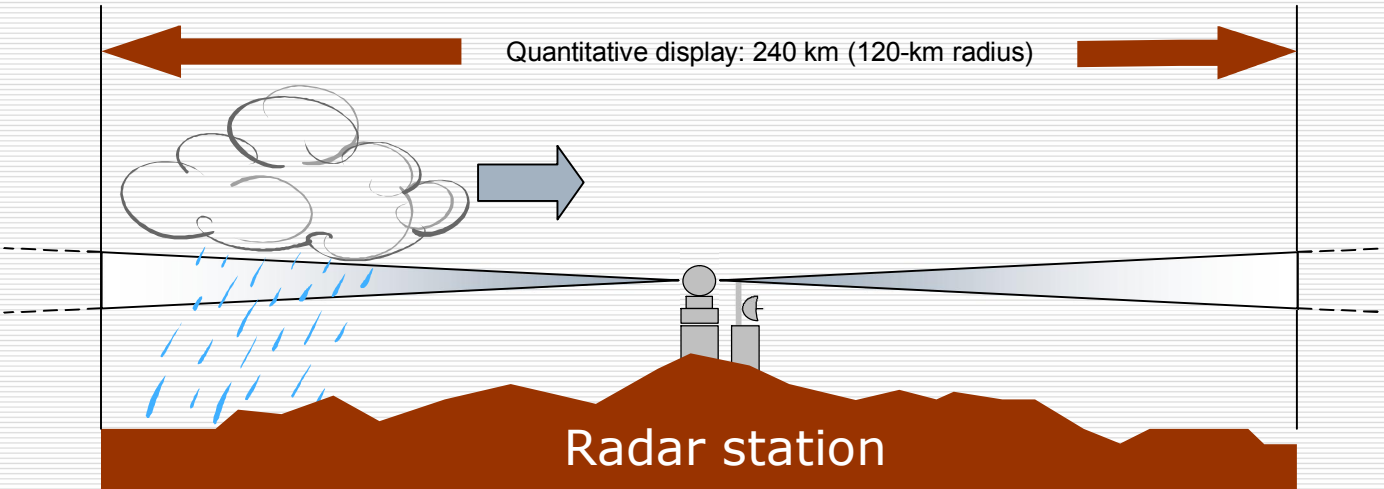
Measuring the rainfall over a wide area

Conventional rain gauge system

Conventional rain gauge system
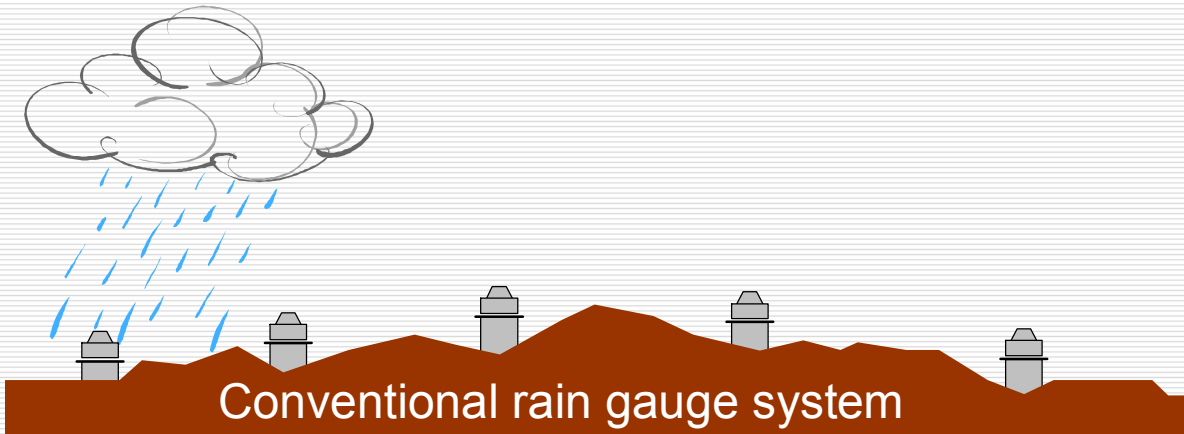
Capable of measuring rainfall amount only at the point of observation

At present, both radar and conventional rain gauge systems are in use.

Area

Rain cloud

Direction and velocity

Intensity

Capable of monitoring the area and intensity of rainfall every five minutes, and predicting the direction of advance of the rain area and changes in intensity.

2-1-2. Locations of radar rain gauges

Radar rain gauges have been installed at 26 locations throughout the country.

Mt. Otobe

Mt. Hako

Mt. Muri

Mt. Shirataka

Mt. Yakushi

Mt. Pinneshiri

Hijiri Plateau

Mt. Nishi

Mt. Hohdatsu

Mt. Monomi

Mt. Fuka

Mt. Takasuzu

Mt. Ohwa

Mt. Akagi

Mt. Rakan

Mt. Ohgusu

Mt. Shaka

Mt. Mitsutohge

Mt. Happongi

Mt. Jyatohge

Mt. Gozaisho

Mt. Johgamori

Mt. Takagi

Mt. Myojin

Mt. Kunimi

Mt. Yae
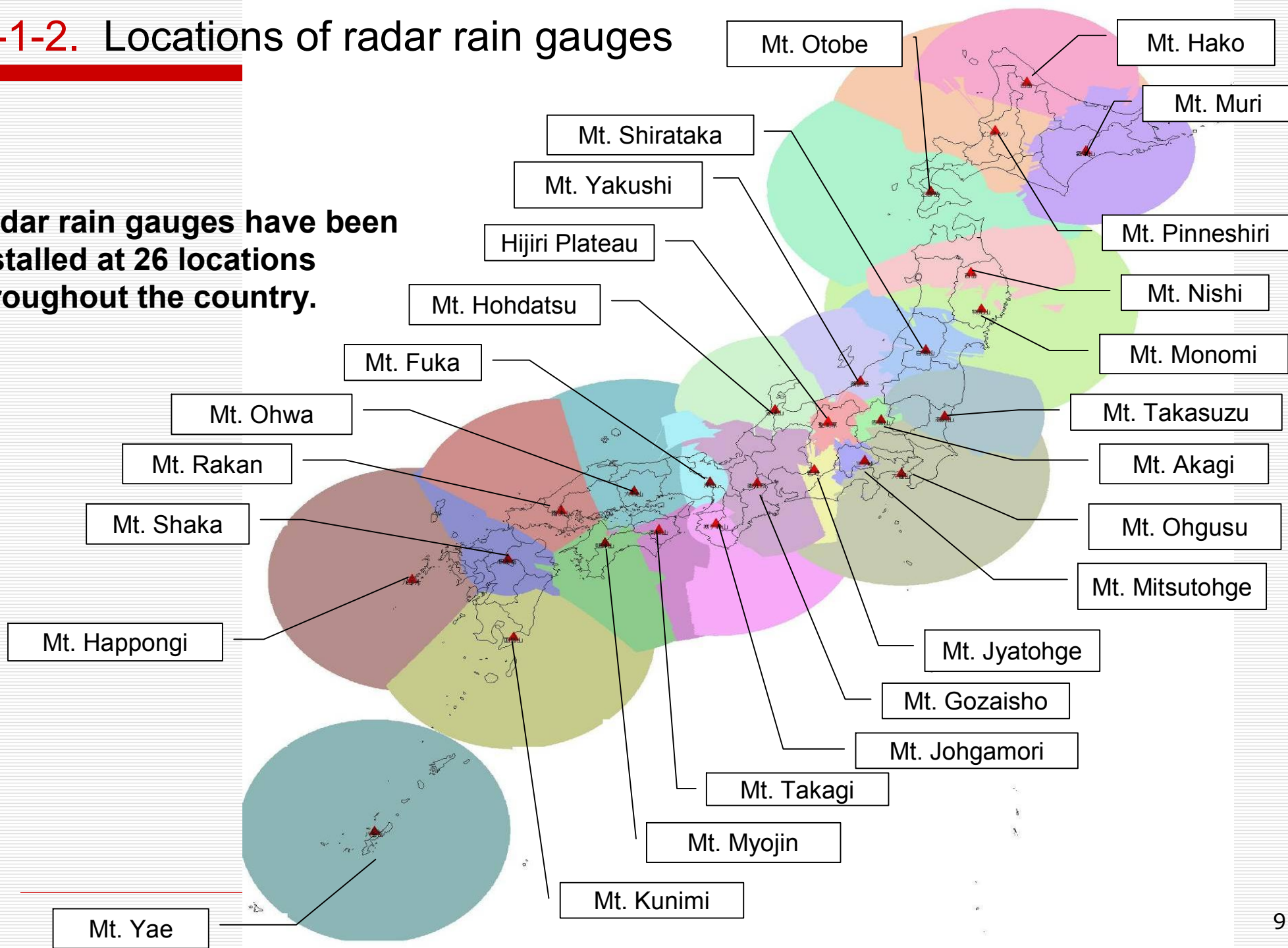
2-1-3. CCTV network

Ministry of Land, Infrastructure and Transport, Regional Development Bureaus and River Offices have real-time access to 3,900 CCTV images available on IP (Internet protocol) network.

CCTV images are used for developing disaster control plans.

Sample dynamic image
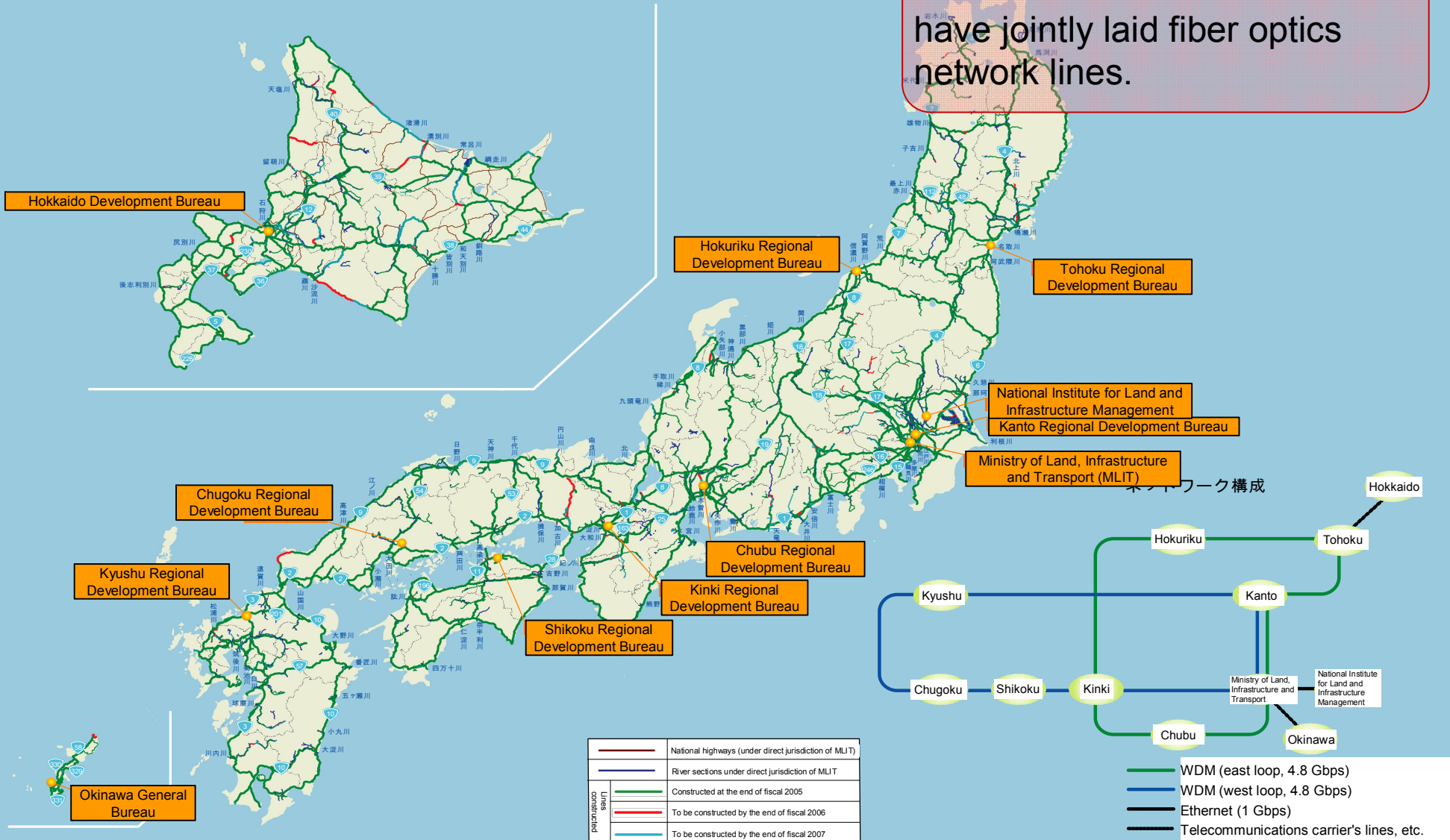(Yodo River in Osaka on August 14, 2007)

Number of CCTV sets installed

	Estimate at the end of March, 2007				
	Road	River	Sediment control	Other	Total
Hokkaido	1,095	**725**	55	17	1,892
Tohoku	841	**610**	36	64	1,551
Kanto	1,153	**1210**	58	91	2,512
Hokuriku	521	**525**	147	66	1,259
Chubu	999	**662**	101	27	1,789
Kinki	697	**766**	55	46	1,564
Chugoku	711	**685**	-	99	1,495
Shikoku	657	**299**	30	40	1,026
Kyushu	742	**1070**	84	52	1,948
Okinawa	50	**46**	-	-	96
Total	7,466	**6598**	566	502	15,132

10

2-1-4. Fiber optics network

River Bureau and Road Bureau have jointly laid fiber optics network lines.

Hokkaido Development Bureau

Hokuriku Regional Development Bureau

Tohoku Regional Development Bureau

National Institute for Land and Infrastructure Management

Kanto Regional Development Bureau

Ministry of Land, Infrastructure and Transport (MLIT)

Chugoku Regional Development Bureau

Chubu Regional Development Bureau

Kyushu Regional Development Bureau

Kinki Regional Development Bureau

Shikoku Regional Development Bureau

Okinawa General Bureau

ネットワーク構成

	National highways (under direct jurisdiction of MLIT)
	River sections under direct jurisdiction of MLIT
Lines constructed	Constructed at the end of fiscal 2005
	To be constructed by the end of fiscal 2006
	To be constructed by the end of fiscal 2007

Hokkaido

Hokuriku

Tohoku

Kyushu

Kanto

Chugoku   Shikoku   Kinki

Ministry of Land, Infrastructure and Transport

National Institute for Land and Infrastructure Management

Chubu

Okinawa

WDM (east loop, 4.8 Gbps)
WDM (west loop, 4.8 Gbps)
Ethernet (1 Gbps)
Telecommunications carrier's lines, etc.

2-1-5. Fiber optics network lines laid by River Bureau

Fiber optics network lines have rapidly been laid for sixteen years since fiscal 1998.

Fiscal year	Cumulative total length of lines (km)				
	River	Dam	Sediment control	Seacoast	Total
1996	414	211	148	0	773
1997	523	256	188	2	969
1998	1,431	704	544	29	2,707
1999	2,289	890	729	38	3,945
2000	4,249	961	1,155	72	6,437
2001	6,135	1,010	1,583	106	8,833
2002	7,619	1,163	2,110	142	11,034
2003	7,670	1,305	2,211	150	11,336
2004	7,719	1,419	2,293	152	11,583
2005	7,760	1,576	2,361	152	11,849
2006	7,822	1,636	2,434	154	12,046

(Source: Data collected by River Bureau in January 2006)

2-2. Processing of real-time data

2-2-1. Building a system for centrally controlling and providing data
- Establishing the Foundation of River and Basin Integrated Communications (FRICS), Japan
- Developing an integrated river information system

2-2-2. Providing prediction data (forecasting and warning)
- Flood forecasting and warning

2-2-1. Uniform river information system

- The uniform river information system aims at sharing and standardizing river administration data including river water levels and rainfall amounts.

- River information systems developed by individual regional development bureaus have been integrated into a national river information system. Regional development bureaus can customize the system according to their requirements.

- Non-structural measures have been separated from structural measures, and the cost of improvement and life-cycle cost have been reduced.

- The system also provides rainfall forecasts of Japan Meteorological Agency and rainfall amount data of the Road Bureau.

4

2-2-2. Flood forecasting and warning

Radar rain gauge data

Rainfall amount and water level observation station

Meteorological data

Rainfall amount and water level data

Joint announcement
(flood forecast exchange system)

Ministry of Land, Infrastructure and Transport

Prefectural government

Japan Meteorological Agency

Flood forecasting

Flood warning

(The central government disseminates information via prefectural government.)

Municipality

Mass media

Issue flood warnings

2-3. Provision of real-time data

- ● **Data provided to**
  - ➢ Disaster prevention organizations (e.g. prefectural and municipal governments, and media)
  - ➢ -Data provision to the public has recently been emphasized.

- ● **Data provision tools**
  - ➢ The Internet
  - ➢ -Cellular phones or other tools

Data provision to the public via the Internet and cellular phone

- River disaster prevention data such as water levels, rainfall amounts and dam-related parameters have been disseminated since fiscal 2001 via the Internet and cellular phone.
- Numerous improvements have been made since fiscal 2007 such as additional provision of data of prefectural governments and applicability to all cellular phone service companies.

Cellular phone (since April 2001)
*Applicable to multiple carriers including *au* and *Softbank* since April 2007.

The Internet since April 2001.

Internet-based "river disaster prevention information"

<div style="border: 2px solid red; text-align: center;">

Information to be provided

</div>

- Radar rain gauge data

- Telemetry data (water levels, rainfall amounts, etc.)

- Flood forecasting and warning

- Dam-related parameters (notice of release of water from the reservoir, reservoir water storage, etc.)
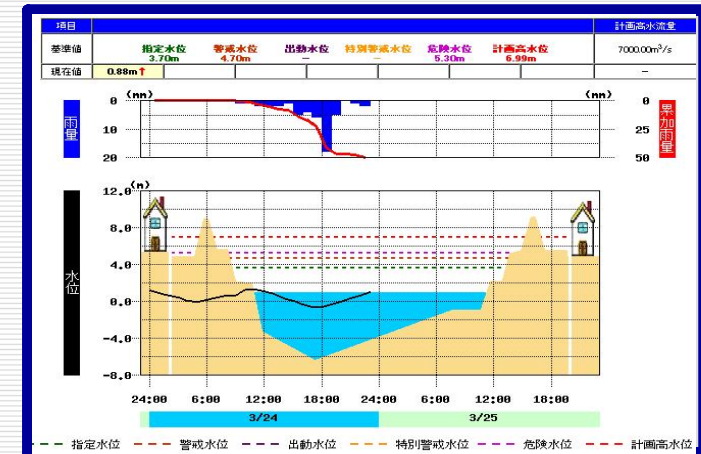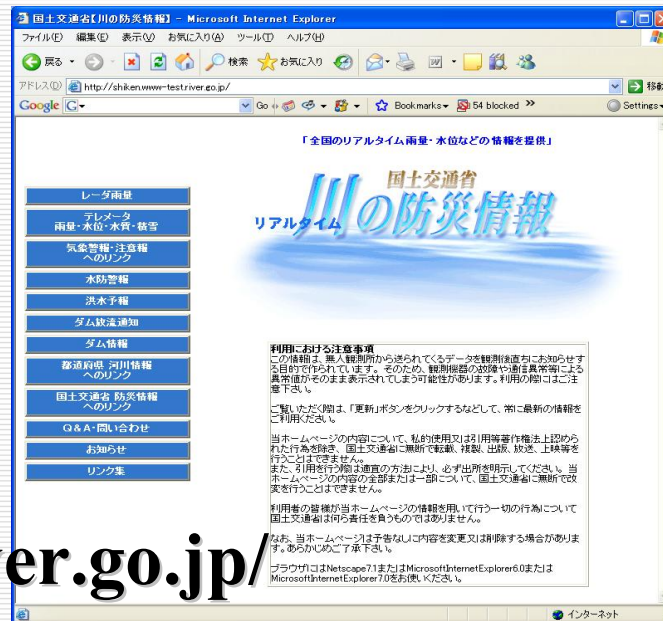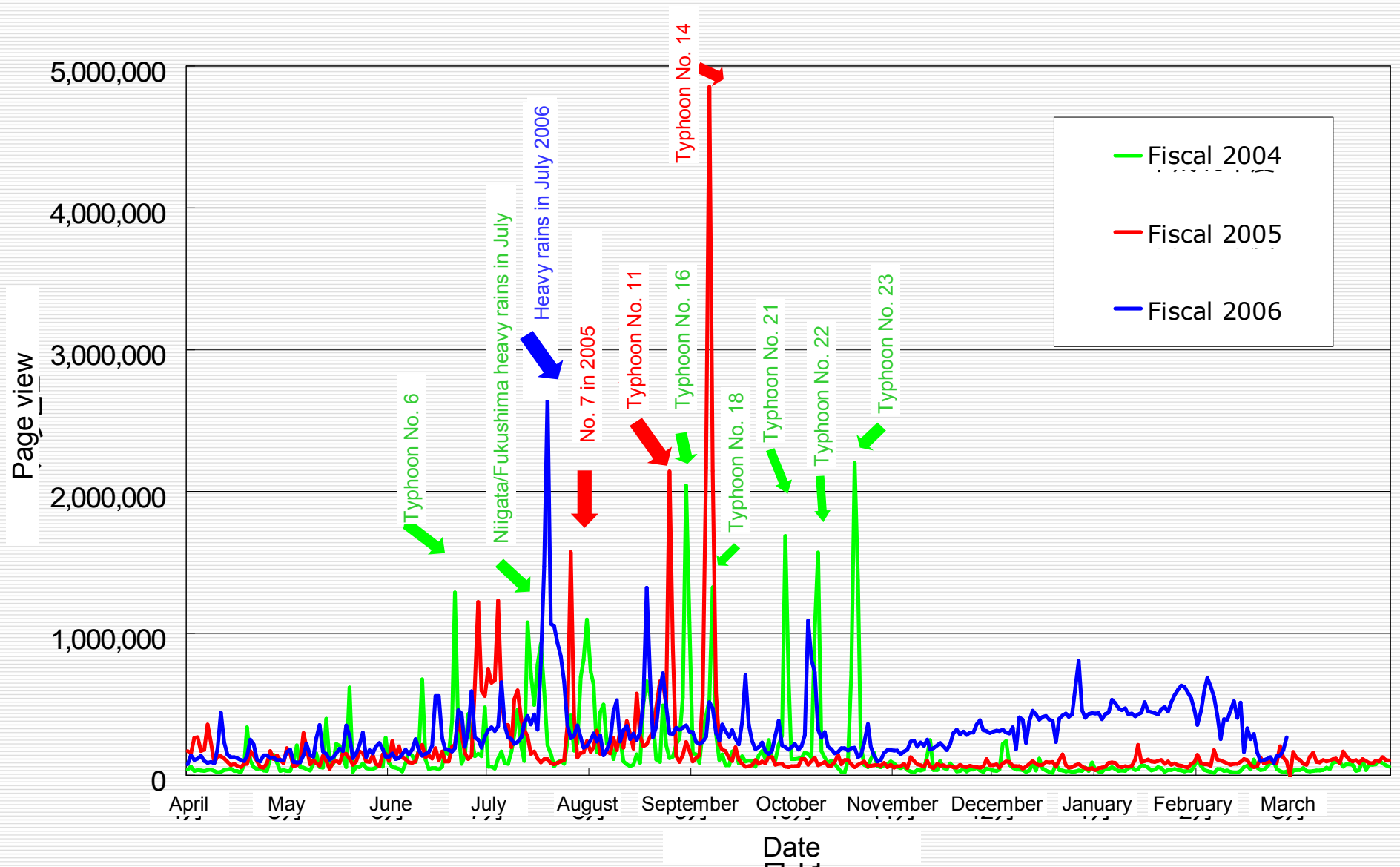

Water level graph

http://www.river.go.jp/
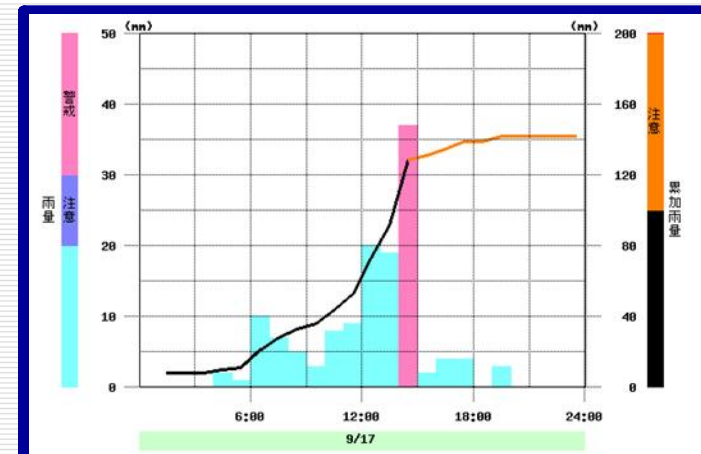
Hyetograph

◇Portal of "river disaster prevention information" website

Frequency of access to Internet-based "river disaster prevention information"

Frequency of access to Internet-based "river disaster prevention information" (in page views per day)

Data provision to municipalities

- Information is provided to municipalities that is equivalent to that for river administrators to facilitate evacuation during a disaster.

- A portal of the website is provided that indicates various basic data such as the mean rainfall amounts and water levels in small basins, and is customized to meet the requirements of each municipality.

- Dedicated information servers are placed in service to ensure stable information dissemination at the time of a disaster when data traffic is congested.
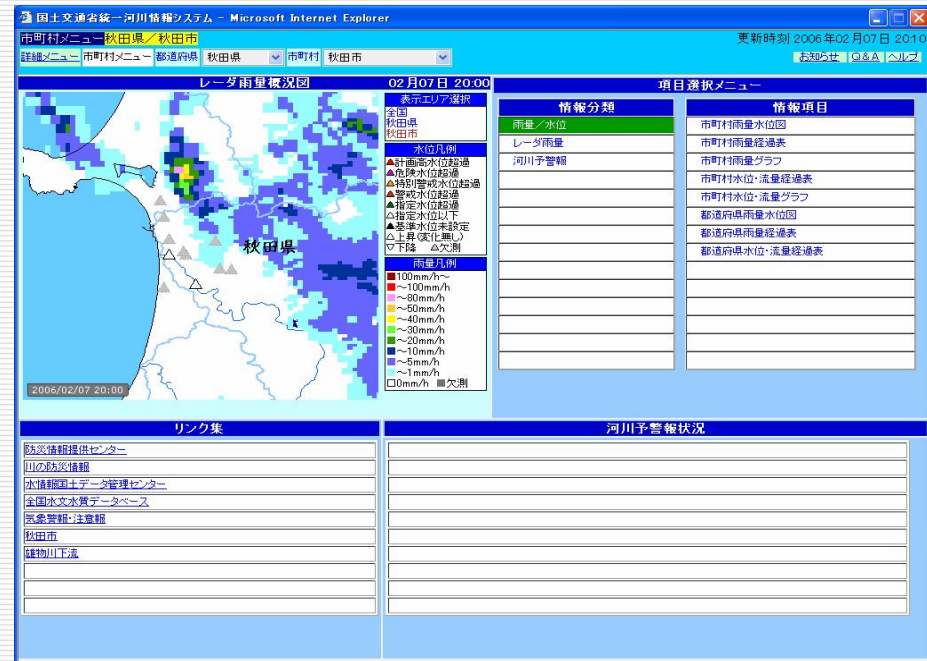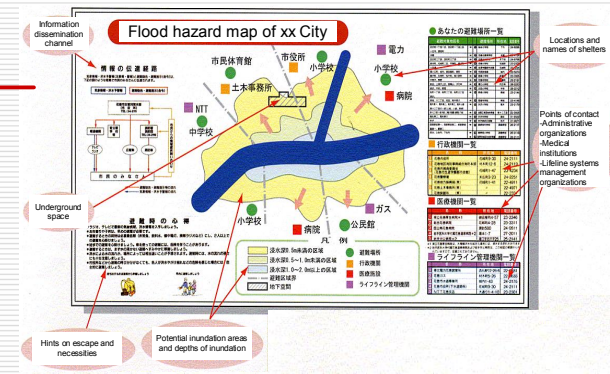

Sample portal

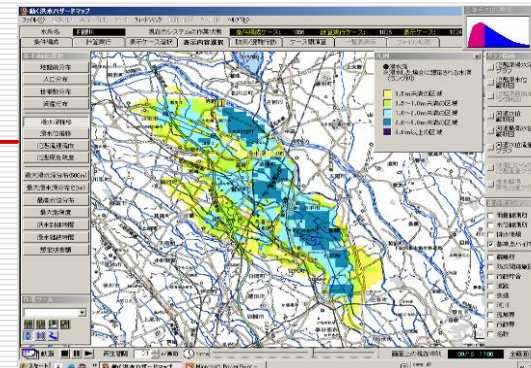# 3. Provision of disaster information under normal conditions

● Potential inundation area map
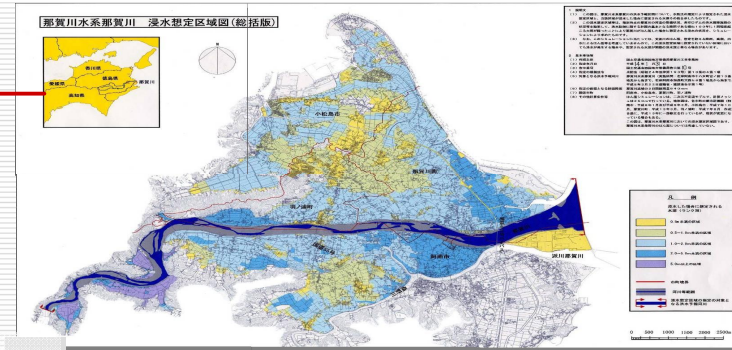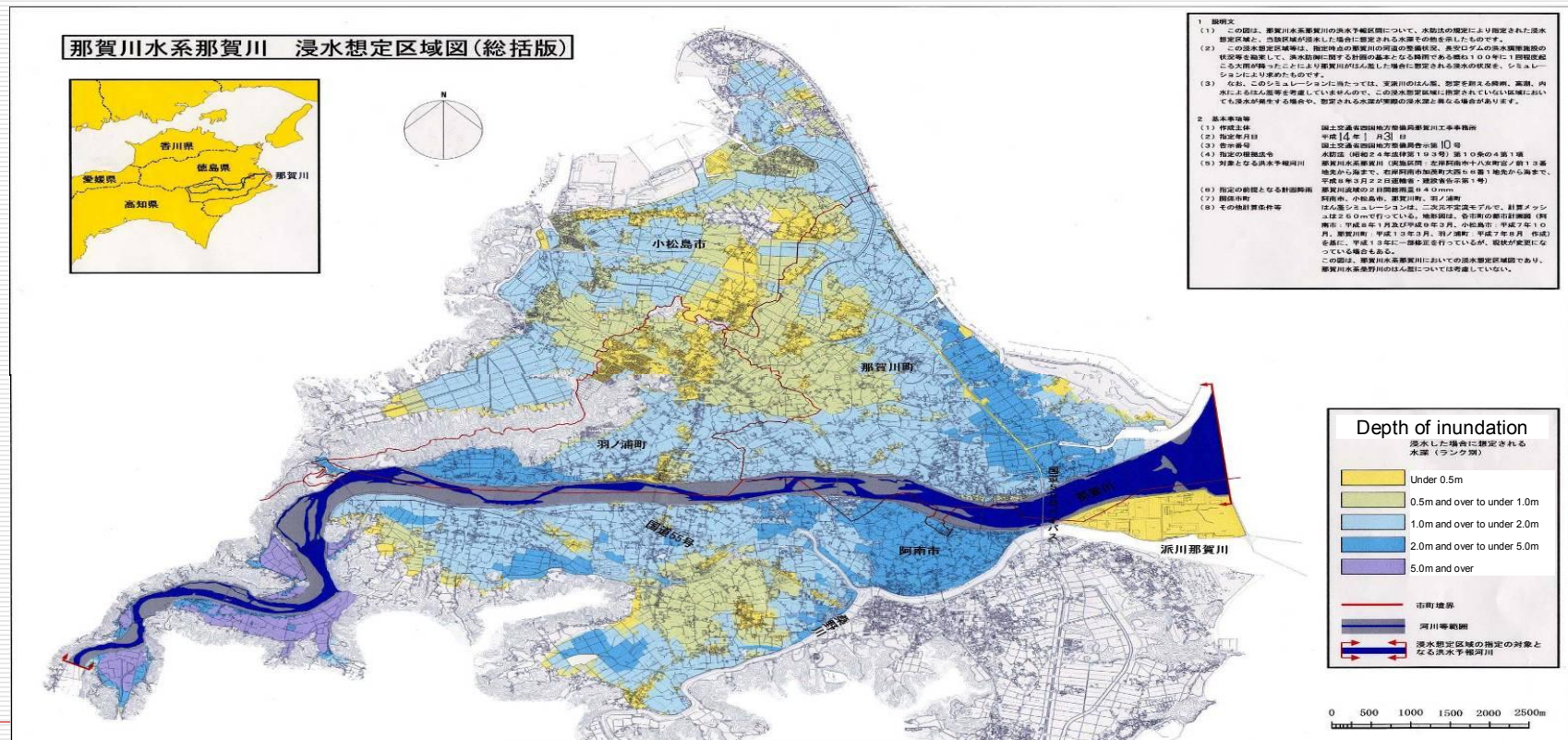
● Hazard map prepared by a municipality

● Animated hazard map

3-1. Potential inundation area map

● River offices provide potential inundation area maps for all Class-A rivers.

● Maximum depth of inundation and inundated area are displayed during a design flood.

Sample potential inundation area map

Flood hazard map of xx City

Image of a hazard map

Information dissemination channel

Locations and names of shelters

Electric power company

Municipal office

Civic gymnasium

Elementary school

Elementary school

Public engineering office

Hospital

NTT

Junior high school

Points of contact
-Administrative organizations
-Medical institutions
-Lifeline systems management organizations

Underground space

Gas company

Elementary school

Hospital

Community center

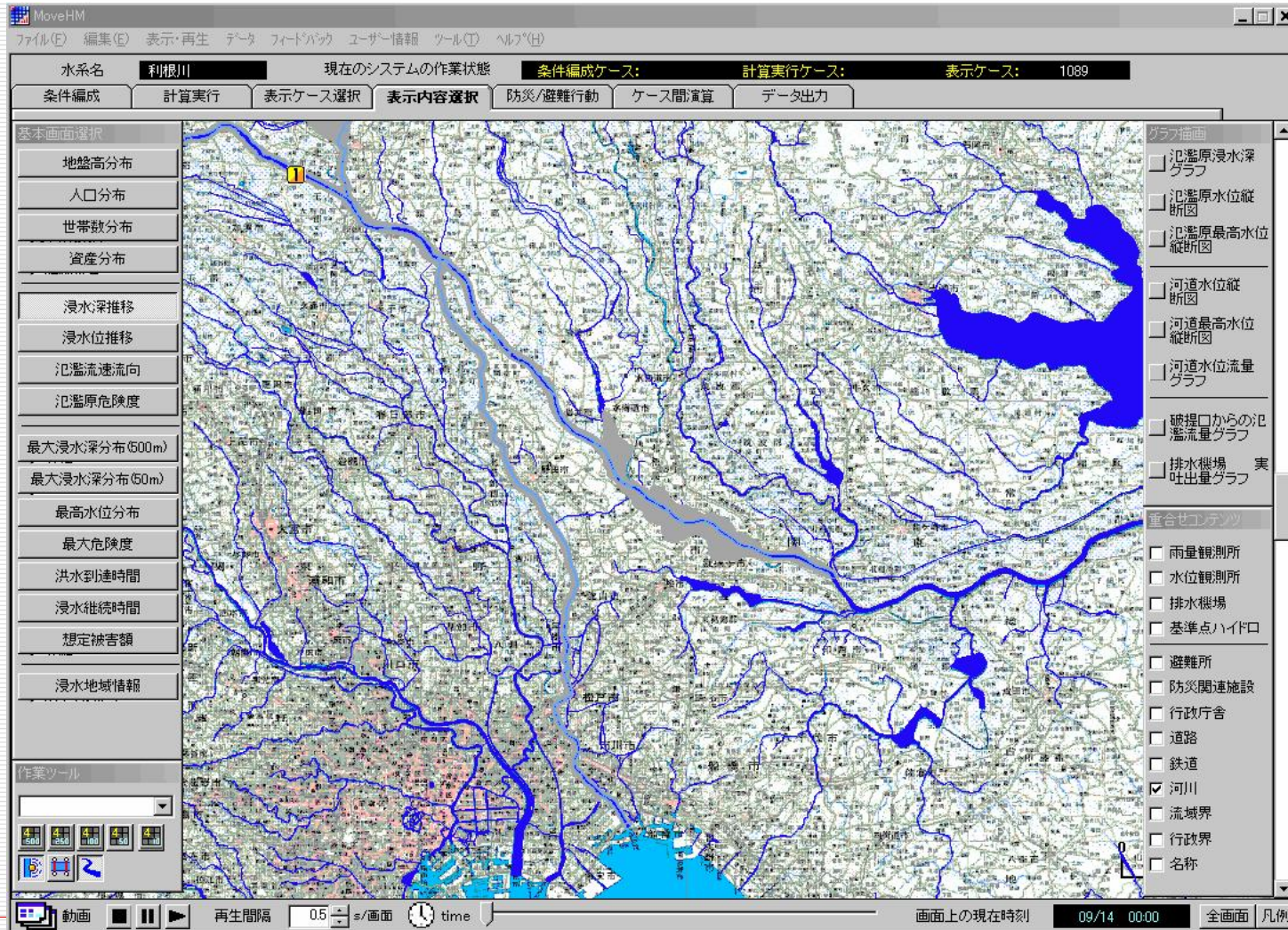Hints on escape and necessities

Potential inundation areas and depths of inundation

3-3. Animated hazard map

☐Having hands-on experience using the virtual reality technology

Making calculations concerning floodwaters and displaying the results real time help determine whether people should be evacuated or not, or which escape route should be taken.

4. Future steps

4-1. Collection of data
- Increasing the density of observation, and shifting the focus from points to lines and areas

4-2. Processing of data
- Increasing the accuracy of prediction and forming a group of experts on flood prediction

4-3. Provision of data
- Providing customized data
- Using greater varieties of data provision tools (e.g. use of ubiquitous networks and terrestrial digital broadcasting)
- Ensuring the interactive communications
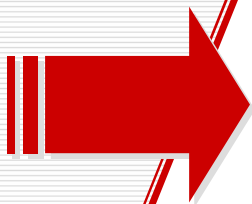
Establishing a subcommittee for future river administration in ubiquitous computing society
Chairperson: Mr. Ken Sakamura, Professor of the University of Tokyo

Future river administration (under normal conditions)

- River space is automatically monitored linearly or area-wide 24 hours a day and 365 days a year using CCTV cameras and sensor networks.

- Maintenance efficiency is enhanced by using the techniques for identifying the deterioration of facilities with sensors, and organizing information for managing the history of facilities (river administration records).

Automating maintenance work

Image of "future river administration" under normal conditions

Present river administration

Patrol and inspection

Person on patrol Inspection of an embankment Inspection of facilities

Embankments and facilities are subjected to visual inspections or patrol for abnormal conditions or deformations.

No abnormal conditions detected   Abnormal conditions detected

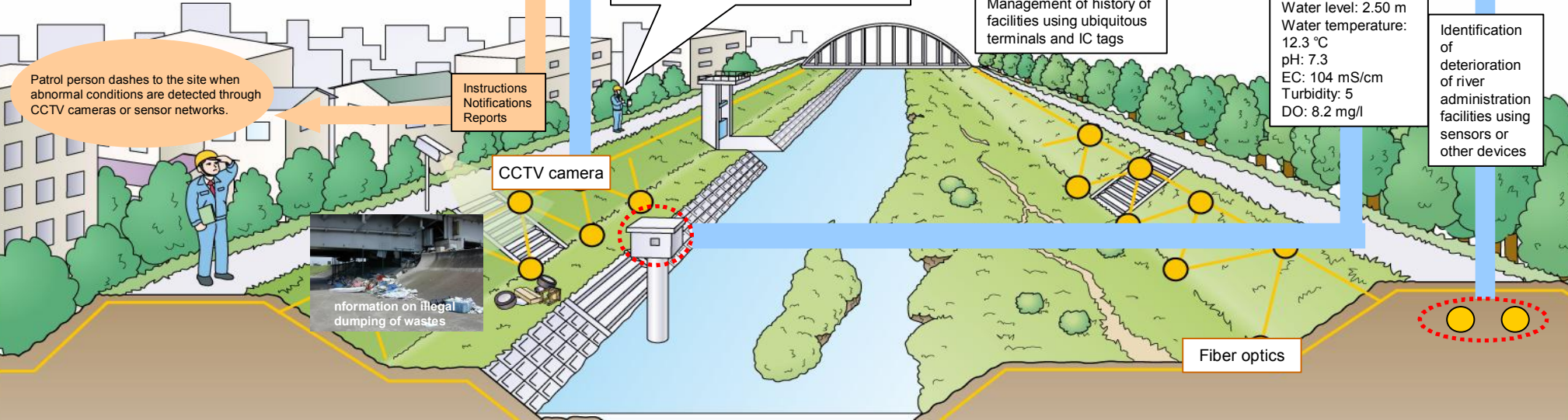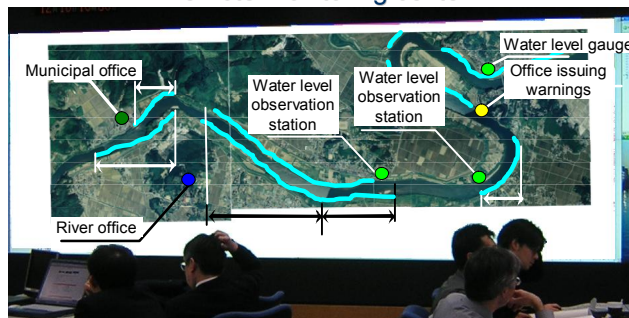**Recording inspection results**

Organizing master files

Taking corrective measures

Retrieving past records

Remote monitoring center

Water level gauge

Municipal office

Water level observation station

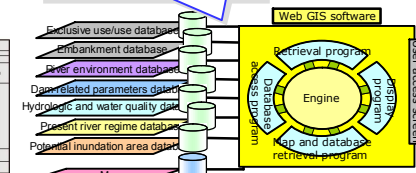Water level observation station

Office issuing warnings

River office

Early detection of abnormal conditions and quick response through 24-hour-a-day, 365-day-a-year monitoring.

Database

Standardize the interface

Web GIS software

Exclusive use/use database
Embankment database
River environment database
Dam-related parameters database
Hydrologic and water quality data
Present river regime database
Potential inundation area data

Retrieval program
Engine
Map and database retrieval program
Maps

Display program
Database access program
User access screen

Centralization of refined observation data

Connection to database
Update of database

Confirmation of information

Real-time information on river conditions

Management of history of facilities using ubiquitous terminals and IC tags

Water level: 2.50 m
Water temperature: 12.3 ℃
pH: 7.3
EC: 104 mS/cm
Turbidity: 5
DO: 8.2 mg/l

Identification of deterioration of river administration facilities using sensors or other devices

Patrol person dashes to the site when abnormal conditions are detected through CCTV cameras or sensor networks.

Instructions
Notifications
Reports

CCTV camera

nformation on illegal dumping of wastes

Fiber optics

Future river administration (under abnormal conditions)

- Conditions of facilities and water levels in the river are monitored linearly or area-wide using CCTV cameras and sensor networks.

- Risk can be forecast using technologies providing highly accurate data, and facilities can be operated in a refined manner.

- Information sharing among disaster control organizations helps take quick and highly efficient actions in the initial stages.

Refining risk management

Image of "future river administration" under abnormal conditions

Present river administration

Person on patrol

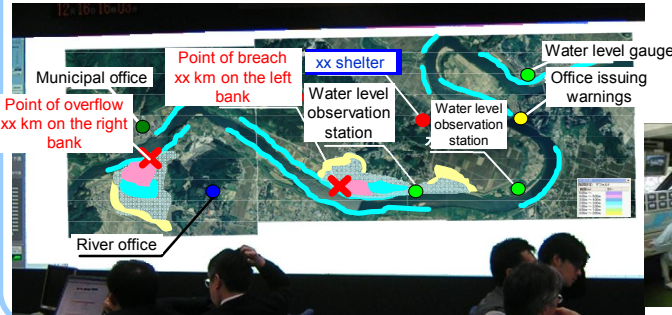Water level at an observation station

Image obtained by a CCTV camera

Disaster control room

Gate-side control

Dam operation based on the data on the present condition

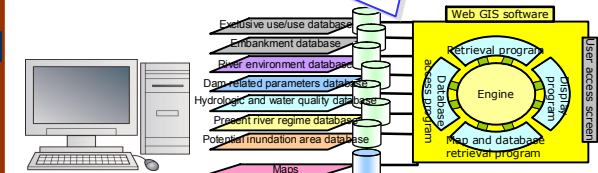Disaster control room (remote monitoring center)

Municipal office

Point of breach xx km on the left bank

xx shelter

Water level observation station

Water level observation station

Water level gauge

Office issuing warnings

Remote operation

Point of overflow xx km on the right bank

River office

Highly accurate forecasting (e.g. water levels and rainfall amounts)

Database

Standardize the interface

Web GIS software

Exclusive use/use database
Embankment database
River environment database
Dam related parameters database
Hydrologic and water quality database
Present river regime database
Potential inundation area database
Maps

Retrieval program
Display program
Engine
Database access program
Map and database retrieval program

User access screen

Centralization of refined observation data

Sophisticated operation of facilities based on typhoon and heavy rain forecasts

Remote operation

Reporting on the point of damage using ubiquitous terminals and IC tags

Connection to database Update of database

Confirmation of information

Installation of hot line between the head of municipality and river administrator

Information dissemination using cameras built into cellular phones and digital radio equipment

Instructions Notifications Reports

Detection of leakage through embankments using sensors or other devices

Flood fighting team member

CCTV camera

Identification of the profile of water level

Fiber optics

Thank you for your attention.